


Original Research Article

# Diabetes mellitus alters the pulmonary function test parameters among the patients attending regular check-up in tertiary care hospital in and around Chennai - Evidence-based study

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## Abstract

**Introduction:** The application of epidemiology to the study of DM has provided valuable information on several aspects of this disease such as its natural history, prevalence, incidence, morbidity, and mortality in diverse populations around the world. Identification of the cause of the disease and the possible preventive measures that could be instituted to arrest or delay the onset of this disease which has reached epidemic proportions in both the developed and the developing nations. Unfortunately, the improvement in outcomes for individual patients with diabetes has not resulted in similar improvements from the public health perspective.

**The aim of the study:** The purpose of this study was to evaluate pulmonary functions in patients with type 2 diabetes mellitus and to determine their correlations with an anthropometric profile, glycemic control, and duration of diabetes.

**Materials and methods:** The present case-control study was carried out in the Department of Diabetology, Melmaruvathur Adiparasakthi Institute of Medical Sciences and Research during the period of 2015. The study included previously diagnosed type 2 diabetes mellitus cases and healthy controls as not having diabetes. In this study, there were a larger number of females than males (66.2% vs. 33.8%). The probable cause for this discrepancy was the fact that many males were

excluded Test (VPFT) were studied in all participants. FVC, FEV1 and FEV1% were selected for the study on account of their smoking history, alcohol intake, irresponsible behavior, busy working schedule while female diabetics were mostly eligible on account of their being non-smokers and other favoring factors. 60 age and sex-matched healthy subjects served as controls. Forced expiratory spirometry was recorded by RMS medspiror Ventilatory Pulmonary Function.

**Results:** A total of 30 previously diagnosed Type 2 Diabetes Mellitus patients (cases) and 30 healthy controls were recruited during the study period. Cases and controls were matched according to their mean age, sex, height, weight, body mass index (BMI). Diabetic patients showed a greater decline in FVC, FEV1, FEF 25-75%, PEFR and increase in FEV1/FVC ratio which is statistically significant, suggesting restrictive lung disorder.

**Conclusion:** The pattern of abnormal pulmonary function observed in our study, low FVC and preserved FEV1/FVC ratio, is suggestive of the restrictive type of lung disease among type 2 diabetics. Diabetic patients showed impaired lung function independent of smoking. Although it was not associated with severity duration of DM affect *FVC* and *FEV<sub>1</sub>*. Lungs are indeed affected in patients with diabetes and pulmonary function testing should be mandatory for diabetics in order to prevent complications thereby improving quality of life.

## Key words

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Comparison, Healthy Controls, Pulmonary Function Test, Type 2 Diabetes.

## Introduction

Diabetes mellitus (DM) is accompanied by widespread biochemical, morphological, and functional abnormalities which may precipitate certain complications that affect the neural, cardiovascular, renal systems, and also organs and tissues like skin, liver, collagen, and elastic fibers. It is indeed a multi-system disorder that affects many organs of the body [1]. The complications related to diabetes pose a significant healthcare burden and disrupt the overall quality of life. The metabolic disorder is a risk factor precipitating microvascular pathologies leading to autonomic neuropathy, nephropathy, retinopathy, and macrovascular pathologies leading to coronary artery diseases, cerebrovascular accidents, and peripheral vascular diseases [2]. The respiratory diseases associated with diabetes may result in changes in pulmonary volumes, diffusion, and elastic properties of lungs as well as the performance of respiratory muscles [3]. Several histopathological changes are also seen in diabetics. Some researchers like Ljubic, et al., showed that diabetes could lead to the development of pulmonary complications due to collagen and elastin changes. While others suggest that

increased non-enzymatic glycation of proteins and peptides of the extracellular matrix at chronic high circulating glucose levels may also have an important role in the pathological changes of the lungs in DM patients. Autonomic neuropathy involving respiratory muscles may occur in these patients [4]. Also, since the prevalence of diabetes in Asian Indians is among the highest in the world, it would be important to study pulmonary functions in this subgroup. Hence the present study was undertaken to determine if there is a difference in pulmonary function in patients with type 2 diabetes and healthy controls. Western interference has led to loss of physical activity and changes in food pattern from traditional unprocessed natural ingredients to highly refined energy-dense fatty and sugary fast foods. These two core factors will be responsible for the high incidence of diabetes in the years to come. The global prevalence of diabetes is projected to be highest in Asian Indians by 2025 (57.2 million), hence it is pertinent to study pulmonary function abnormalities in this subgroup [5].

## Materials and methods

The present case-control study carried out in the

Department of Diabetology, Melmaruvathur Adiparasakthi Institute of Medical Sciences and Research during the period of 2015. The study included previously diagnosed type 2 diabetes mellitus cases and healthy controls as not having diabetes. In this study, there were a larger number of females than males (66.2% vs. 33.8%). The probable cause for this discrepancy was the fact that many males were excluded. Test (VPFT) were studied in all participants. FVC, FEV1 and FEV1% were selected for the study on account of their smoking history, alcohol intake, irresponsible behavior, busy working schedule while female diabetics were mostly eligible on account of their being non-smokers and other favoring factors. 60 age and sex-matched healthy subjects served as controls. Forced expiratory spirometry were recorded by RMS medspiror Ventilator Pulmonary Function. The procedure of lung function tests was explained to all the study and control subjects to remove any apprehension. We also told them about the complications of type 2 diabetes mellitus and the importance of early screening. Patients with occupational lung diseases, those exposed to excessive dust at their workplaces, tuberculosis, chest injuries, chronic obstructive lung disease cases and those who were smokers were excluded from the study. The physical characters such as height in centimeters and weight in kilograms of all the study subjects were recorded and the data were entered into the computer to get predicted values for pulmonary function. All the subjects were motivated prior to the initiation of maneuver. We explained all the subjects in detail regarding the maneuver and demonstrated the maneuver until they got acquainted with it. The subject was then asked to perform the procedure to gain confidence to perform the maneuver before taking up the actual test. The test was performed thrice and the best among the three readings was chosen. The data were statistically analyzed using Student's unpaired t-test and the results for each parameter were compared between diabetics and the controls.

### Statistical analysis

Statistical analysis was carried out by statistical package of social sciences (SPSS) version 18.0. Mean and standard deviation were computed for all continuous variables and comparison was done using Student's t-test. Frequencies were generated for categorical variables and compared with chi-square test.

### Results

In a case-control study, we studied 30 type 2 diabetic patients and 30 Non-diabetic patients. Case and controls were selected by applying inclusion and exclusion criteria using random sampling method. Detailed anthropometric and physiological data were collected. In our study as per **Table – 1, 2**, mean of FBS, PPBS and HbA1c were co-related in diabetic and control group with PFTs. By applying Karl Pearson's correlation coefficient we found out that, a negative co-relation exist between glycemic parameters and PFT's and by applying student "t" test to it we see that the above co-relation was significant with p-value being  $< 0.05$  in the diabetic group. Hence we concluded that there was an inverse correlation between glycemic and pulmonary function parameters. Spirometry was performed and Forced vital capacity (FVC), Forced expiratory volume in 1 second (FEV1), and FEV1/FVC are recorded. Peak expiratory flow rate (PEFR) and FEF 25-75% were recorded by Spirometer and the results were compared with age and sex-matched control (nondiabetic) subjects. Statistical analysis was done by calculating Mean  $\pm$  SD, using Student's t-test, Karl Pearson correlation, and ANOVA test.

There was a highly significant difference between mean values of Fasting blood sugar, postprandial sugar level and HBA1c in Diabetic group and Control (Non-diabetic) group (i.e.  $p < 0.01$ ), by student's t –paired test.

By applying Student's Unpaired t" test there is a highly significant difference between mean values of FVC, FEV1, FEV1/FVC PEFR and FEF 25-75% (i.e.  $p < 0.01$ ) in Diabetic group and Control (Non-diabetic) group.

**Table - 1:** Level of blood glucose profile among diabetic subjects vs non-diabetic subjects.

Parameters	Group I (Diabetic) (n=30)	Group II (Non-diabetic) (n=30)	p value	Significance
	Mean ± SD	Mean ± SD		
Fasting Blood Sugar	174.34±50.39	81.7±11.74	p<0.01	Highly significant
Postprandial Blood Sugar	265.19±54.06	112.26±14.71	p<0.01	Highly significant
HbA1c	9.13±1.66	4.33±1.01	p<0.01	Highly significant

**Table - 2:** Comparison of PFT between type II diabetics (cases) and controls.

Parameters	Cases (Diabetic patients)	Controls	P value
FVC	2.68±0.12	3.45±0.23	P<0.001*
FEV1	1.83±0.52	3.34±0.59	P<0.001*
FEV1/FVC	56.2±17.6	48.8±3.9	P<0.001*
FEF25%-75%	3.16±1.34	4.23±1.04	P<0.001*
PEFR	4.38±2.09	7.39±1.22	P<0.001*

(All values were expressed as Mean ± SD. \* indicates highly significant value)

## Discussion

DM is a systemic disease, which also affects lungs causing the restrictive type of ventilatory changes, because of glycosylation of connective tissues, reduced pulmonary elastic recoil and inflammatory changes in lungs [6]. The histopathological changes in the lungs of diabetics are associated with the thickening of the alveolar epithelium and the pulmonary capillary basal lamina and also due to the reduced recoiling of the lung. This is caused by biochemical alteration of connective tissue constituents, particularly collagen and elastin. There is increased cross-linkage formation between polypeptides of collagen which leads to thickening, leading restriction of lung volume and alveolar gas transport, reduced membrane diffusion capacity and pulmonary capillary blood volume [7]. Pathophysiology for the deteriorated pulmonary capacity in diabetic patients is not fully understood. Few histopathological reports are in favor of basal lamina thickening and fibrotic changes in the lung parenchyma [8]. The pattern of abnormal pulmonary function observed in our study, low FVC and preserved FEV1/FVC ratio, is suggestive of the restrictive type of lung disease. This can be explained on basis of chronic hyperglycemia leading to non-enzymatic glycosylation of connective tissues

[9]. As non-enzymatic glycosylation has been shown to occur in human lung parenchymal tissue. The present study showed that all the pulmonary parameters, that is, FVC, FEV<sub>1</sub>, FEF<sub>25-75</sub>, MVV, and PEFR were significantly reduced except FEV<sub>1</sub>/FVC in patients with type 2 DM as compared with the healthy controls ( $P < 0.001$ ). The ratio FEV<sub>1</sub>/FVC is greater in diabetic patients ( $P > 0.05$ ). Well, comparable findings of a reduction in all parameters of PFT in DM type 2, was reported by other authors observed that lung function parameters like forced vital capacity (FVC), forced expiratory volume in one second (FEV<sub>1</sub>), FEV<sub>1</sub>/FVC ratio, have shown a significant reduction in type 2 diabetes of longer duration [10]. Some authors like Verma, et al. [10] and Ali, et al. [2] also reported that there is a significant average reduction in FVC, and FEV<sub>1</sub> in type 2 diabetic patients, and it is also demonstrated that peak expiratory flow rate (PEFR) and forced expiratory flow in 25-75% (FEF<sub>25%-75%</sub>) may be lower in diabetics, which is inversely related to the duration of the disease [11]. Furthermore in the present study association not found between PFT and severity of illness and similar findings were observed by other authors [11].

## Conclusion

In our study, we conclude that Diabetes is associated with significantly impaired dynamic Pulmonary Functions. There is Mixed Pattern (restrictive and obstructive) of Pulmonary Dysfunction. The pulmonary parameters are affected in patients with diabetes, and PFT should be essentially done in these patients for better management. There was a decrease in FVC, FEV1, FEF25%-75%, PEFr and increase in FEV1/FVC as compared to their controls. This reduced lung function is likely to be a chronic complication of diabetes mellitus which was a particularly restrictive pattern. Early screening of lung functions has to be undertaken to know the pathology setting in, at the earliest as prevention is always better than cure.

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